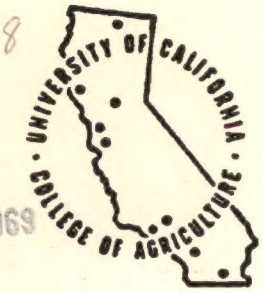

DIVISION OF AGRICULTURAL SCIENCES
UNIVERSITY OF CALIFORNIA

ECONOMIES OF SCALE IN CALIFORNIA TURKEY PRODUCTION

Vernon R. Eidman
Gerald W. Dean
Harold O. Carter

CALIFORNIA AGRICULTURAL EXPERIMENT STATION
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ECONOMIES OF SCALE IN CALIFORNIA TURKEY PRODUCTION

by

Vernon R. Eidman*, Gerald W. Dean**, and Harold O. Carter***

INTRODUCTION

The turkey industry has experienced a number of changes in recent years. At the grower level, changes concerned ration formulation, development of labor-saving feed handling equipment, improved disease control, and the development of numerous off-farm grower financing arrangements. Changes at the industry level included those in the volume of turkey meat produced, the relative importance of the several producing regions, the number of producers, the typical size of enterprise, and the marketing of turkey meat.

The volume of turkey meat production in the United States has been increasing at a rapid rate since 1950. The number of turkeys raised increased from 44.4 million in 1950 to 108.1 million in 1961, declined to 92.4 million in 1962, and increased steadily again through 1965. Table 1 shows that the trend in California production has closely paralleled this national trend. California producers have accounted for 15.1 to 19.4 percent of the national output in each of the years 1950-1966, making the State either first or second in turkey production during each of the 16 years. The annual average live weight prices declined rapidly during the early 1950's for both the United States and California.

Turkeys are raised in each of the 50 states. Bawden, et al.[1/] showed that turkey production in the East and West North Central areas of the United States

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*Eidman, Vernon R., Assistant Professor of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma.

**Dean, Gerald W., Professor of Agricultural Economics and Agricultural Economist in the Experiment Station and on the Giannini Foundation, University of California, Davis.

***Carter, Harold O., Professor of Agricultural Economics and Agricultural Economist in the Experiment Station and on the Giannini Foundation, University of California, Davis.

1/ Bawden, D. Lee, H. O. Carter, and G. W. Dean, "Interregional Competition in the United States Turkey Industry," Hilgardia, Volume 37, No. 13, June 1966, pp. 437-531.

TABLE 1

Number of Turkeys Raised and Average Farm Level Prices
for the United States and California 1950-1966

Year	Number of turkeys raised		U.S. total raised in California	Average price per pound at farm level	
	United States	California		United States	California
	thousand		percent	cents	
1950	44,393	7,202	16.22	32.9	28.5
1951	53,298	9,507	17.84	37.5	36.7
1952	62,327	11,123	17.85	33.6	31.0
1953	59,822	9,899	16.55	33.7	31.1
1954	67,693	10,196	15.06	28.8	26.4
1955	65,598	10,196	15.54	30.2	28.8
1956	76,741	12,643	16.47	27.2	26.9
1957	81,164	14,666	18.07	23.4	21.9
1958	78,349	13,639	17.41	23.9	22.7
1959	84,493	13,047	15.44	23.9	24.9
1960	84,772	14,536	17.15	25.4	25.5
1961	108,131	17,765	16.43	18.9	19.4
1962	92,365	17,963	19.45	21.6	20.5
1963	93,370	15,082	16.15	22.3	21.7
1964	99,678	15,737	15.79	21.0	20.8
1965	104,740	15,667	14.96	22.2	22.9
1966	115,507	16,972	14.69	23.0	23.2

Source: California Crop and Livestock Reporting Service, California Prices Received by California Producers for Farm Commodities, Sacramento: 1908-1958 and 1959-1966, processed.

has been expanding more rapidly than other areas of the country. During the 1956-1961 period, production in these two areas expanded 66 and 81 percent, respectively, in the West only by 37 percent and in the South Central by 26 percent. In the North and South Atlantic regions, production decreased 21 and 10 percent, respectively. The study also indicated that future turkey production is likely to shift to the Midwest and South, with the West (including California) declining. This interregional study was based on representative costs of production and processing for each area of the country and suggests that in future years only the most efficient turkey growers will compete successfully in California.

While the number of turkeys raised in California has been increasing, production has been shifting toward fewer but larger flocks. Table 2 shows the number and percentage of total for California flocks of different sizes for the years 1954, 1959, and 1961. Flock size is defined as the number of turkeys slaughtered for one firm. These data show a sharp decrease in both the number and relative importance of smaller flocks, while larger flocks increased in both these categories. By 1961, the total number of producers had declined to 638, less than one-half the total seven years before.

The number of turkeys marketed by size of flock and the proportion of total turkeys marketed by size of flock from July 1, 1960-June 30, 1961 (referred to hereafter as 1961) are reported in the final two columns of Table 3. These data indicate that the 20.9 percent of producers, raising less than 2,000 turkeys per year, accounted for only 0.6 percent of California's production, while the 8.9 percent in the 50,000-plus flock size produced 59.0 percent of the marketed turkeys.

The number of turkeys marketed by size of flock and type of producer are also shown in Table 3 for 1961. Most growers were classified as either independent or contract growers. Those producers raising a portion of their turkeys under contract and the remainder under their own financing were classified as combination growers. The financial and contractual arrangements of some, referred to as unidentified growers, could not be determined. These data show that contract growers tended to be larger than independent growers.

The number of growers by size of flock and type of producer is summarized in Table 4. Assuming that the unidentified producers were divided between independent and contract production in the same proportion as the identified producers, 31.8 percent of the growers produced 45.3 percent of California's 1961

TABLE 2

Number and Percentage of California Turkey Producers by Size of Flock

Size of flock	1954		1958		1961	
	number	percent	number	percent	number	percent
100 - 1,999	418	30.2	135	17.2	133	20.9
2,000 - 4,999	391	28.2	133	17.0	101	15.8
5,000 - 9,999	332	24.0	191	24.5	129	20.2
10,000 - 14,999	110	8.0	92	11.8	71	11.1
15,000 - 19,999	50	3.6	83	10.6	49	7.7
20,000 - 29,999	48	3.5	63	8.1	53	8.3
30,000 - 49,999	17	1.2	46	5.9	45	7.1
50,000 plus	18	1.3	38	4.9	57	8.9
TOTAL number of producers	1,384	100.0	781	100.0	638	100.0

Source: Data for 1954 and 1959: California Department of Agriculture, Bureau of Marketing, "Improving the Marketing of Turkeys," Marketing Survey Report No. 18, Sacramento, 1962. Data for 1961: California Department of Agriculture, "Monthly Reports of Turkeys Received for Processing," deposited with the Department, Sacramento, 1961.

TABLE 3

Turkeys Marketed by Size of Flock and Type of Producer[a/]

Size of flock	Independent growers		Contract growers		Combination growers		Unidentified growers		All growers	
	Number of turkeys	Percent	Number of turkeys	Percent	Number of turkeys	Percent	Number of turkeys	Percent	Number of turkeys	Percent
0 - 1,999	68,550	1.1	14,530	0.2	800	0.1	2,520	0.1	86,400	0.6
2,000 - 4,999	147,300	2.4	111,450	2.0	14,250	2.1	67,610	2.7	340,610	2.3
5,000 - 9,999	453,500	7.2	259,050	4.6	15,690	2.4	208,140	8.4	936,380	6.2
10,000 - 14,999	456,540	7.2	276,650	4.9	0	0.0	134,110	5.4	867,300	5.7
15,000 - 19,999	579,160	9.2	143,770	2.5	0	0.0	156,130	6.3	879,050	5.8
20,000 - 29,999	715,090	11.4	469,820	8.3	22,040	3.3	134,980	5.5	1,341,930	8.9
30,000 - 49,999	959,660	15.2	601,150	10.6	0	0.0	180,640	7.3	1,741,450	11.5
50,000 plus	2,916,320	46.3	3,791,150	66.9	613,540	92.1	1,589,540	64.3	8,910,550	59.0
TOTAL	6,296,120	100.0	5,667,570	100.0	666,320	100.0	2,473,670	100.0	15,103,680	100.0
Percentage of TOTAL	41.7		37.5		4.4		16.4		100.0	

a/ Independent growers were those who met all three of the following criteria: (a) furnished or purchased all inputs and, if financing was necessary, arranged for it himself; (b) made all production and marketing decisions; and (c) had the responsibility for risk. A contract producer is one who had entered into a written agreement with an off-farm firm in connection with the production or marketing of turkeys which violated one or more of the criteria for an independent producer. A combination producer raised part of his turkeys under contract and part as an independent producer. An unidentified producer was one who could not be classified as one of the other three types.

Source: Compiled from "Monthly Reports of Turkeys Received for Processing," deposited with the California Department of Agriculture, 1961. Information on the type of financial arrangement was obtained from County Farm Advisors.

TABLE 4

Number of Growers by Size of Flock and Type of Production[a/]

Size of flock	Growers									
	Independent		Contract		Combination		Unidentified		All	
	number	percent	number	percent	number	percent	number	percent	number	percent
0 - 1,999	110	30.1	20	11.5	1	9.1	2	2.3	133	20.9
2,000 - 4,999	43	11.8	33	19.0	4	36.3	21	23.9	101	15.8
5,000 - 9,999	61	16.7	36	20.7	2	18.2	30	34.1	129	20.2
10,000 - 14,999	38	10.4	22	12.6	0	0.0	11	12.5	71	11.1
15,000 - 19,999	32	8.8	8	4.6	0	0.0	9	10.2	49	7.7
20,000 - 29,999	28	7.7	19	10.9	1	9.1	5	5.7	53	8.3
30,000 - 49,999	26	7.1	15	8.6	0	0.0	4	4.5	45	7.1
50,000 plus	27	7.4	21	12.1	3	27.3	6	6.8	57	8.9
TOTAL	365	100.0	174	100.0	11	100.0	88	100.0	638	100.0
Percentage of TOTAL	57.2		27.3		1.7		13.8		100.0	

a/ The definitions of types of operations are given in footnote a/ of Table 3.

Source: Compiled from "Monthly Reports of Turkeys Received for Processing," deposited with the California Department of Agriculture, 1961. Information on the type of financial arrangement was obtained from County Farm Advisors.

turkey crop under contract, while 66.5 percent raised 50.3 percent of total production as independent growers.

PURPOSE OF STUDY

The rapid expansion of turkey meat production in other areas of the country, the apparent competitive disadvantage of California turkey growers, and the rapid shift of California growers to larger operations and to financing by nonfarm firms raises a number of economic questions relating to the cost structure facing California turkey growers. The purpose of this report is to provide answers to such questions as: (1) What are the economies of size or scale in California turkey meat production? and (2) How is the production cost level affected by the number of broods grown, the rate of feed conversion, and mortality rate?

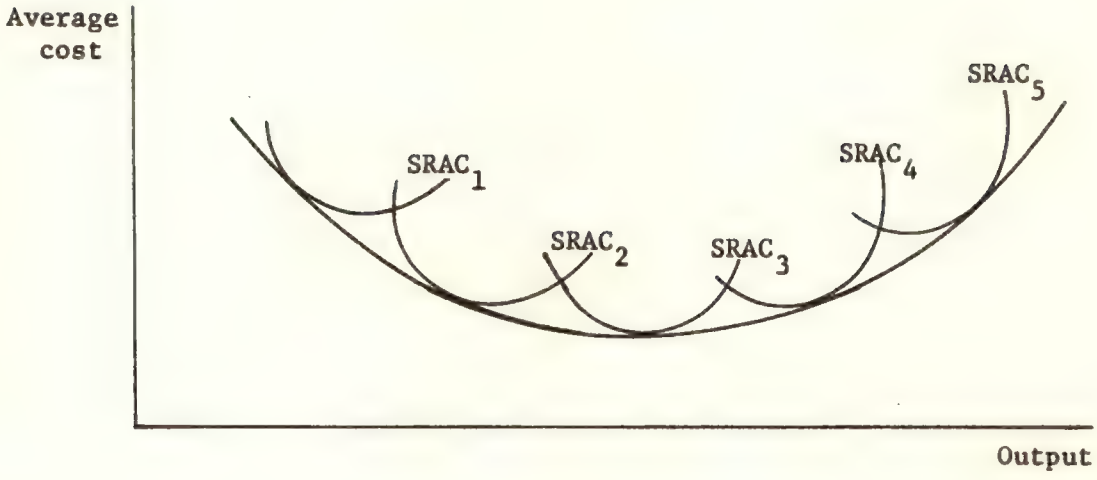
ECONOMIES OF SCALE IN TURKEY MEAT PRODUCTION

The concept of economies of scale is commonly illustrated with reference to the shape of the long-run average cost curve of a firm producing a single homogeneous product. The long-run average cost (LRAC) is derived as the envelope of a series of short-run average cost curves (SRAC) as shown in Figure 1. The short-run curves show the minimum cost for producing each level of output with one or more factors of production taken as given or fixed. The fixed factor usually represents the size of plant such as the brooding facilities in the case of turkey production. The short run is assumed to be sufficiently long to alter the amount of any variable production factors (e.g., the number of poults, the amount of feed fed, etc.), but not long enough to alter the amount of the fixed factors. The long run is considered sufficiently long so that all factors of production, including the size of plant, can be varied. Thus, the long-run average curve (LRAC) in Figure 1 can be derived as the envelope to the series of short-run curves (SRAC) for successively larger fixed plants.

Short-run average cost curves are conventionally considered to be "U"-shaped; i.e., first decreasing with the spreading of fixed costs over more units of output, but finally increasing as a result of diminishing marginal physical product as more of the variable factors are combined with the fixed factors. In turkey production, overcrowding of poults in brooding facilities can be expected to lead to rapidly increasing mortality rates and consequently, eventually increasing short-run average costs.

FIGURE 1

Theoretical Shape and Position for the
Short- and Long-Run Average Cost
Curves of a Typical Firm



As the scale of plant is increasing, the minimum average cost of production may be at successively lower levels, resulting in economies of scale; may be at the same level, resulting in constant returns to scale; or it may be at successively higher levels of costs, resulting in diseconomies of scale. Figure 1 shows all three phases of this sequence, resulting in a "U"-shaped long-run average cost curve. The reasons underlying a "U"-shaped long-run average cost curve are usually summarized in terms of net internal and external economies and diseconomies of scale. Our study considers only internal economies and diseconomies. Net internal economies arise primarily from the reduction in technological coefficients as factors are combined more efficiently with larger sizes, or as prices paid for factors of production decrease (e.g., quantity discounts on feed or poult purchases). After an initial portion of declining average production costs, all available technological and pecuniary economies are probably exploited and the long-run average costs may remain approximately constant over a wide range of output. At some size, net internal diseconomies may appear because of increasing average cost of supervision, higher incidence of disease, or other factors. In most empirical studies, net internal diseconomies are extremely difficult to measure meaningfully.

We derived the empirical estimates of the short- and long-run average cost curves from budgeting the production costs of various sizes of turkey meat production operations. We synthesized the combinations of fixed and variable inputs in these operations, based on engineering estimates of the physical quantities of these factors needed and their market prices. The advantage of the synthesis technique is that it allowed us to "construct" fixed plants with the optimum combination of inputs for the specified plant capacity and to synthesize as many of these plants as necessary to estimate the total range of the long-run average cost curve. The long-run average cost curve can then be fitted as an envelope curve to the synthesized short-run average cost curves.

Estimating Procedures for Economies of Scale Relationships

The data used in estimating the cost curves were obtained from a variety of sources. Used were personal interviews with Extension specialists working with turkey growers, representatives of feed manufacturing firms, turkey growers, published summaries of turkey growers' records, unpublished growers' records obtained from contracting firms, and published feeding standards. Specific references to the sources are made in the relevant portions of this section.

Fixed Costs

The complement of land, buildings, and equipment necessary for the production of a given number of turkeys is considered fixed in the short run. All of the items included in this group--land, brooder houses, range shelters, feeders, waterers, sprinklers, fence, tractor, feed wagon, and feed storage bins--are durable items in the sense that they may be used for more than one year's production. Hence, the annual cost of using this complement of equipment is the fixed charge appropriate for any year's service. The annual cost or fixed charges to the producer includes depreciation, interest on the investment, maintenance, taxes, and insurance.

California turkeys are typically grown in drylot pens rather than in confinement or on open range. Day-old poults are purchased and placed in the brooder house. At six to nine weeks of age (depending on the season of the year) the poults are moved to drylot pens. Feeding and watering in brooder houses is done with automatic equipment. Range feeders are typically filled using a tractor and a self-unloading feed wagon. Drylot pens generally allow 15 to 20 square feet per turkey and contain approximately 2 square feet of shade per bird, automatic waterers, and a sprinkler system to settle dust and cool the turkeys on hot days. The turkeys remain in the pens until marketed. In the past, many California producers have attempted to produce turkeys on a year-round basis, raising three to four broods per year. Year-round use of brooding facilities encourages disease buildup and heavy mortality rates. Consequently, production currently is typically carried out using brooding facilities for two broods per year and growing pens for one brood per year. This allows facilities to stand idle a sufficient length of time between broods to prevent the effects of disease buildup.

The annual cost for fixed inputs has been derived for eight alternative brood sizes (5,000, 10,000, 15,000, 20,000, 25,000, 35,000, 50,000, and 100,000). These eight brood sizes were selected as those representative of the range in size of the majority of commercial California turkey producers. Growers raising 10,000 birds per year (two broods of 5,000 birds) or less would need to have alternative employment for labor not required by the turkey enterprise. Hence, it seemed essential to have minimum brooder facilities of 5,000-bird capacity (10,000 birds per year with two broods). A turkey operation with 20,000 to 25,000 birds produced per year would provide relatively full employment for one man. Two men working full time can feed and care for 50,000 turkeys per year; three men can handle 100,000 birds per year.

The complement of equipment developed for the eight brood sizes assumes that the brooding facilities are used twice per year and the growing pens once. The annual costs for only one brood per year have also been computed for the eight brooder-house sizes mentioned above. In this case, only one-half the amount of range equipment used for two broods is needed.

Amounts and prices of fixed inputs.--The size and quantity of buildings and equipment assumed by size of operation is given in Table 5. These quantities are typical of the equipment used by efficient turkey growers.[1/] Assumed are 1 square foot of floor space per poult in the brooder house, 2 square feet of shade per poult on range, 50 linear feet of watering space per 1,000 birds in growing pens, and 10 circular range feeders per 1,000 birds in drylot. Numbers of sprinklers by size of operation are based on recommendations by Schroeder and Rooney.[2/] Fencing requirements are based on the assumption that 10,000 turkeys in drylot are kept in a pen 100 feet by 1,700 feet which is partitioned into five equal sized pens holding 2,000 turkeys each. This provides 17 square feet of space per turkey. Feeding on range is done with a tractor and power takeoff operated self-unloading wagon. Storage bins of sufficient capacity to hold a truckload of feed are provided for all sizes of enterprise considered. Four feed bins are required for two broods of turkeys because hens and toms on range are fed different levels of protein, and, with two broods, four different feeds are used during several weeks of the growing season. Three acres of land are specified for brooding, growing, and for storage of feed and equipment for each 5,000 turkeys produced. The prices used for fixed inputs are given in Table 6. These purchase prices are based on the prices of new items available to growers in the Central Valley area of California or the construction cost (including labor costs of the item). These prices and discounts given for quantity purchases were obtained from firms supplying the items to California turkey growers.

Annual fixed costs.--The method of computing the annual costs for one and two broods for the eight sizes of operation is summarized in Table 7. Annual costs include depreciation, interest on the investment, maintenance, property

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1/ Asmundson, V. S., and F. H. Kratzer, Turkey Production in California, Berkeley: California Agricultural Extension Service, Circular No. 110, revised, October 1951, 60 pp.

2/ Schroeder, J. P., and W. F. Rooney, Sprinklers for Turkeys, Berkeley: University of California Agricultural Extension Service, Publication No. AXT-85, 1962, processed.

TABLE 5

Quantity of Building Space and Equipment Required by Size of Operation and Number of Broods

Investment item	Unit	Size I 5,000 Birds		Size II 10,000 Birds		Size III 15,000 Birds		Size IV 20,000 Birds		Size V 25,000 Birds		Size VI 35,000 Birds		Size VII 50,000 Birds		Size VIII 100,000 Birds	
		Broods															
		1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Brooder house with feeding equipment	1,000 sq. ft.	5	5	10	10	15	15	20	20	25	25	35	35	50	50	100	100
Range shelters (22 x 26 ft.)	number	20	40	40	80	60	120	80	160	100	200	140	280	200	400	400	800
Round range feeders	number	50	100	100	200	150	300	200	400	250	500	350	700	500	1,000	1,000	2,000
Automatic waterers (8 ft.)	number	20	40	40	80	60	120	80	160	100	200	140	280	200	400	400	800
Sprinklers	nozzles	17	35	35	70	52	105	70	140	87	175	122	245	175	350	350	700
Fencing	rods	125	250	250	500	375	750	500	1,000	625	1,250	875	1,750	1,250	2,500	2,500	5,000
Tractors	number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Self-unloading wagons	number	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Bulk feed bins (24 ton)	number	2	4	2	4	2	4	2	4	2	4	2	4	3	5	6	10
Land	acres	3	6	6	12	9	18	12	24	15	30	21	42	30	60	60	120

Source: Adapted from Asmundson, V. S., and F. H. Kratzer, Turkey Production in California, Berkeley: California Agricultural Extension Service Circular 110, Revised, October 1951, 60 pp.

TABLE 6

Purchase Prices for Investment Items[a/]

Investment item	Quantity	Price per unit
	units	dollars
Brooder house with automatic feeding equipment	5,000 sq. ft. or larger	1.25
Range shelters (22 x 26 ft.)	10 or more	150.00
Round range feeders	50 - 299	28.00
	300 - 599	26.00
	600 or more	22.00
Automatic waterers (8 ft.)	20 - 124	25.80
	125 - 249	22.50
	250 or more	18.00
Sprinklers	15 or more nozzles	20.00
Fencing	100 rods or more	3.47
Tractor (30 h.p.)	1	3,750.00[b/]
Self-unloading wagon	1	2,500.00[c/]
Bulk feed bins (24 ton)	2 - 5	1,680.00[c/]
Land	3 - 60 acres	500.00[d/]

a/ Prices quoted were obtained from commercial concerns supplying these items to California turkey growers.

b/ Based on Reed, A. D., Machinery Costs and Performance, Davis: California Agricultural Extension Service, 1964, p. 2, processed.

c/ Based on Strong, Horace T., Richard G. Jones, Robert F. Miller, and Ray V. Parker, Farm Feeding Beef Cattle to Market Home-Grown Feeds, Berkeley: California Agricultural Extension Service Circular 453, 1956, p. 22.

d/ The price of land used in turkey production varies from $300 to $1,000 per acre. The figure of $500 per acre is used as an average value.

TABLE 7

Method of Computing Annual Costs

Item	Depreciation		Interest (based on average value)[a/]	Maintenance (based on new cost)[b/]	Property tax per $100.00 average value[c/]	Fire and extended insurance per $100.00 average value[d/]
	Expected life	New value				
	years		percent		dollars	
Brooder house with feeding equipment	20	5	6	4	1.79	0.60
Portable range shelters (22 x 26 ft.)	10	10	6	6	1.79	0.60
Round range feeders	10	10	6	6	1.79	0.60
Automatic waterers (8 ft.)	10	10	6	6	1.79	0.60
Sprinklers	10	10	6	6	1.79	0.60
Fencing	10	10	6	6	1.79	0.60
Tractors	10	10	6	e/	1.79	0.60
Self-unloading wagon	10	10	6	e/	1.79	0.60
Bulk feed bins (24 ton)	25	4	6	1	1.79	0.60
Land	--	--	6	--	1.79	--

a/ Average value is computed as the depreciated value of the asset in the median year of its expected life.

b/ The percentage values for buildings and range equipment are based on a study by Jolliff, Marvin O., and Robert C. Suter, Turkeys: Costs and Returns, Lafayette: Purdue University, Department of Agricultural Economics, May 1962, 27 pp., processed.

c/ The $1.79 tax rate is based on an average California tax rate of $7.80 per $100.00 assessed value, and an average ratio of assessed to full cash value of assessed property of 0.23 as reported by California State Board of Equalization, Annual Report 1961-62, Sacramento: December, 1962, pp. 9-12.

d/ Insurance rates are based on state-wide commercial rates of $0.42 to $0.59 for fire and $0.10 for extended coverage. An assumed rate of $0.50 for fire and $0.10 for extended coverage per $100.00 of average value is used.

e/ Maintenance charges for this item are based on the hours of annual use.

taxes, and insurance. Total investment and annual costs for the eight buildings and equipment combinations are shown in Table 8.

Variable Costs

Variable cost items change with the number of turkeys grown. The variable inputs in turkey meat production are feed, labor, poults, machinery operating expenses and repairs, medication, litter, insurance on the poults, electricity and fuel, miscellaneous items, and interest on the capital necessary to finance these variable cost items.

Growers' records from feed companies and from the California Extension Service were used to provide the cost items for some of the variable factors mentioned above and were used as "bench marks" to check other synthesized values.[1/] The ten variable-cost items can be divided into two groups on the basis by which they were derived. The feed cost, labor cost, and machinery-operating costs were using feeding standards, labor-use standards, and the purchase prices of these items. The remaining variable-cost items were computed as the average values paid by growers.

Feed costs.--Estimation of feed costs relate directly to assumptions of consumption, growth rate, mortality, and feed prices. Weekly feed consumption and average cumulative weight for broad-breasted bronze hen and tom turkeys, as shown in Table 9, are based upon Feed Consumption Standards developed by M. L. Scott, Cornell University.[2/] Major commercial feed companies recommend 28-30 percent protein content for day-old poults as compared to 14-16 percent for birds in the final feeding period prior to marketing. Moreover, the protein level fed to hens is ordinarily decreased at an earlier age than for tom turkeys because hens mature more rapidly. For the analysis, we assume six discrete time periods with varying protein levels as shown in Table 10.

The sample growers' records show that California producers typically market hen turkeys at 18 to 20 weeks of age and tom turkeys at 23 to 25 weeks of age. The decision on the exact marketing age, once the birds reach a marketable weight, may vary somewhat from grower to grower due to market conditions

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1/ Schroeder, J. Price, California Turkey Meat Production Costs, Berkeley: University of California Agricultural Extension Service, 1964, processed.

2/ Schroeder, J. Price, Turkey Feed Consumption, Weight Gains and Conversion Costs, Berkeley: University of California Agricultural Extension Service, 1963, 4 pp., processed.

TABLE 8

Total Investment and Annual Cost
by Size of Operation

Building code	Brood size	Total investment a/		Annual cost b/	
		1 Brood	2 Broods	1 Brood	2 Broods
	number	dollars			
I	5,000	23,050	33,620	3,288	4,866
II	10,000	36,510	54,269	5,381	8,226
III	15,000	49,949	73,922	7,474	11,386
IV	20,000	63,409	94,240	9,566	14,678
V	25,000	76,848	114,558	11,659	17,972
VI	35,000	102,586	151,132	15,700	23,739
VII	50,000	144,128	212,025	21,941	33,422
VIII	100,000	282,455	424,050	42,651	66,846

a/ The total investment represents the total quantity of all fixed inputs shown in Table 5 valued at the appropriate prices given in Table 6.

b/ The method of deriving the annual cost is given in Table 7.

TABLE 9

Feed Consumption and Growth Rate
of Broad-Breasted Turkeys

Age in weeks	Hens		Toms	
	Feed per bird	Average weight of hens	Feed per bird	Average weight of toms
	pounds			
1	0.18	0.27	0.20	0.30
2	0.35	0.53	0.40	0.60
3	0.57	0.90	0.60	1.00
4	0.70	1.40	0.90	1.60
5	1.00	1.90	1.30	2.40
6	1.30	2.50	1.40	3.20
7	1.50	3.30	1.90	4.20
8	2.10	4.20	2.10	5.20
9	2.70	5.20	3.30	6.40
10	3.40	6.30	4.10	7.70
11	3.30	7.50	4.40	9.00
12	3.30	8.50	4.40	10.40
13	3.10	9.40	4.50	11.80
14	3.50	10.40	4.80	13.20
15	2.50	11.30	4.70	14.70
16	4.10	12.20	4.80	16.00
17	4.10	13.00	4.70	17.30
18	4.10	13.70	4.40	18.60
19	4.10	14.40	4.60	19.90
20			4.80	21.20
21			5.20	22.50
22			6.30	23.80
23			6.50	25.10
24			6.80	26.40

Source: Adapted from Shroeder, Price, Turkey Feed Consumption, Weight Gains and Conversion Costs, Berkeley: University of California Agricultural Extension Service, 1963, processed.

TABLE 10

Protein Levels Assumed for Broad-Breasted Bronze Turkeys at Various Stages of Growth

Protein content	Age of hens	Age of toms
percent	weeks	
28	1 to 4	1 to 4
24	5 to 8	5 to 8
20	9 to 11	9 to 13
18	12 to 14	14 to 18
16	15 to 17	19 to market
14	18 to market	

Source: Recommendations of major commercial feed companies.

at that time and the grower's short-term price expectations. This study assumes that all hen turkeys are marketed at the end of the nineteenth week of the growing period and all tom turkeys at 24 weeks of age.

Assuming that each 1,000 turkey poults are composed of 500 hen poults and 500 tom poults, the information in Tables 9 and 10 can be used to compute the pounds of each of the six feeds fed per 1,000 turkeys. However, one more factor--mortality during the growing period--must be incorporated into the analysis in order to estimate accurately the feed consumption by a brood of turkeys.

Mortality affects feed consumption in two ways. First, the distribution of mortality over the growing period is important because a poult which dies during the first few weeks consumes little feed, while one dying near market time consumes almost as much feed as a marketed turkey. Secondly, the level of mortality is important because, for any given distribution of death loss over the growing period, a flock having higher mortality will consume less feed for each 1,000 poults started. The distribution of mortality over the growing period can be represented by Equation (1), where m_i is the cumulative proportion

$$(1) \qquad m_i = aw^b$$

$$i = 1, 2, \ldots, 24$$

of the total mortality which has occurred through week i, i takes on the values of the weeks of the growing period, w represents week and takes the values 1, 2, . . ., 24, and a and b are constants to be estimated. This form was selected for the mortality equation because it requires the regression line to run through the origin (i.e., at age zero no mortality has occurred) and because the usual mortality pattern over the growing period shows heavy losses during the initial few weeks of the growing period, followed by declining mortality rates. If we define M as the total mortality rate for the entire growing period, then the rate of mortality which has occurred up to week i is equal to $m_i M$.

The coefficients of Equation (1) were estimated as given in Equation (2)

$$(2) \qquad m_i = 40.623w^{0.27590} \qquad R^2 = 0.855$$

based upon data from growers' records. Mortality by week was converted to the cumulative percentage of total mortality which had occurred through the given week. The predicted values of Equation (2) are converted from percentage values to decimal values for use in the feed consumption formulas.

Because the proportion of turkeys lost is equal to $m_i M$, the proportion alive (P_a) and eating feed in any week i can be represented by Equation (3). If we

$$P_a = (1 - m_i M) \tag{3}$$

define F_{iT} as the number of pounds of feed consumed by 500 live tom turkeys in week i, and F_{iH} as the number of pounds of feed consumed by 500 live hen turkeys in week i, then Equation (4) gives total feed consumed (F_{ci}) in week i per 1,000 turkeys started.

$$F_{ci} = (1 - m_i M)\, F_{iT} + (1 - m_i M)\, F_{iH} \tag{4}$$

It was assumed above that all hen turkeys are sold at the end of the nineteenth week. During weeks 1, 2, . . ., 12, the grower is losing half hen and half tom turkeys, but all turkeys lost in weeks 20 through 24 are tom turkeys. Hence, Equation (4) only holds for weeks 1, 2, . . ., 19. The proportion of live tom turkeys (P_{Ta}) in any week i = 20, 21, . . ., 24 is given by Equation (5).[1/]

$$P_{Ta} = 1 - (m_i - 0.5m_{19})(M) \tag{5}$$

Using the above relationships to account for death loss, and representing by Q_j the pounds of feed with protein level j per 1,000 poults started, Equations (6) to (11) are the feed-consumption equations for each of the six protein feed levels.

$$Q_{28} = \sum_{i=1}^{4} (1 - m_i M)\, F_{iH} + \sum_{i=1}^{4} (1 - m_i M)\, F_{iT} \tag{6}$$

$$Q_{24} = \sum_{i=5}^{8} (1 - m_i M)\, F_{iH} + \sum_{i=5}^{8} (1 - m_i M)\, F_{iT} \tag{7}$$

$$Q_{20} = \sum_{i=9}^{11} (1 - m_i M)\, F_{iH} + \sum_{i=9}^{13} (1 - m_i M)\, F_{iT} \tag{8}$$

$$Q_{18} = \sum_{i=12}^{14} (1 - m_i M)\, F_{iH} + \sum_{i=14}^{18} (1 - m_i M)\, F_{iT} \tag{9}$$

1/ Total hen turkeys lost = $0.5m_{19}(M)$. The cumulative death loss of tom turkeys for any week i = 20, . . ., 24 is $m_i(M) - 0.5m_{19}(M) = (m_i - 0.5m_{19})M$.

$$(10) \qquad Q_{16} = \sum_{i=15}^{17} (1 - m_i M)\, F_{iH} + (1 - m_{19} M)\, F_{19T}$$

$$+ \sum_{i=20}^{24} [1 - (m_i - 0.5 m_{19}) M]\, F_{iT}$$

$$(11) \qquad Q_{14} = \sum_{i=18}^{19} (1 - m_i M)\, F_{iH}$$

Simplifying each of these equations by gathering terms and inserting the values for m_i, F_{iH}, and F_{iT}, the quantity of feed consumed at each of the six protein levels for any given total mortality rate M is given by Equations (12) to (17) below.

$$(12) \qquad Q_{28} = 1{,}950 - 999.29255\ M$$

$$(13) \qquad Q_{24} = 6{,}300 - 4{,}230.09000\ M$$

$$(14) \qquad Q_{20} = 15{,}050 - 11{,}615.00000\ M$$

$$(15) \qquad Q_{18} = 16{,}650 - 14{,}146.80150\ M$$

$$(16) \qquad Q_{16} = 22{,}450 - 14{,}000.72200\ M$$

$$(17) \qquad Q_{14} = 4{,}100 - 3{,}697.11350\ M$$

A list of the prices charged, delivery charges, and quantity discounts available to California turkey growers were obtained from each of the commercial feed companies interviewed. As expected, these prices varied greatly among companies for any given protein level feed and among seasons of the year. The prices adopted for this study are modal values of the prices charged for each of the six protein level feeds delivered to the farm 30 miles from the feed company. The price lists obtained were applicable for the first six weeks of 1964. Quantity discounts, while not always explicitly stated, appeared to be incorporated in the quoted feed prices. These discounts apply to orders for full truckloads of 12 tons and double trailer truckloads of 20 to 24 tons. Generally, a 3-ton order was the minimum order that would be delivered without additional charge. A discount of $1.00 per ton was available for a 12-ton truckload, and a $1.40 per ton discount was available for trailer loads. The assumed prices paid by turkey growers for feed delivered to the ranch in bulk are given in Table 11. The prices are generally quoted as net due within 30 days.

TABLE 11

Modal Prices Paid by Turkey Growers for
Bulk Feeds Delivered to the Ranch

Type of feed	Size of delivery		
	3 to 10 tons[a/]	11 to 20 tons[b/]	21 or more tons[c/]
percent protein	dollars per cwt.		
28	5.89	5.84	5.82
24	5.15	5.10	5.08
20	3.95	3.94	3.92
18	3.88	3.83	3.81
16	3.76	3.71	3.69
14	3.63	3.58	3.56

a/ The 28 percent protein feed is assumed to contain 4 pounds of antibiotic per ton; the 24 percent protein feed contains 2 pounds of antibiotic per ton.

b/ Assumes quantity discount of $1.00 per ton.

c/ Assumes quantity discount of $1.40 per ton.

Source: Modal prices for 30-mile deliveries of major feed companies.

Feed prices are based on the number of tons for a given delivery; feed costs were therefore calculated under the assumption that the feed for each brood is purchased separately. For example, a grower requiring 8 tons of the 28 percent protein feed for each of two broods is assumed to purchase 8 tons at two times, rather than 16 tons at one time and storing half of it for the second brood. Table 12 gives the feed prices assumed for each of the eight brood sizes considered in this study.

Using the feed consumption Equations (12) to (17) and the feed costs of Table 12, total feed-cost equations for the eight sizes of operation are developed and shown in Equations (18) to (22). F_j is the feed cost in dollars per

(18) $F_5 = 2,637.72 - 1,919.73\ M$

(19) $F_{10} = 2,634.40 - 1,917.03\ M$

(20) $F_{15} = 2,632.61 - 1,915.79\ M$

(21) $F_{20} = 2,632.22 - 1,915.59\ M$

(22) $F_{20} = F_{25} = F_{35} = F_{50} = F_{100}$

1,000 poults started for brood size j, where j takes the values 5, 10, 15, 20, 25, 35, 50, and 100 for the eight brood sizes.

Labor costs.--Labor requirements and costs by type of operation for the eight brood sizes are shown in Table 13, based on estimates provided by Extension specialists, growers, and the field men of contracting concerns. These labor requirements were further verified by interviews with a sample of turkey growers representative of the eight brood sizes.

Machinery operating costs.--The cost of maintaining and operating the tractors and self-unloading wagons for each of the eight brood sizes as shown in Table 14 are directly related to the hourly requirements for feeding given in Table 13. Reed[1/] gives the hourly cash operating cost for a 30-horsepower tractor as $0.57 for fuel and $0.38 for repairs. A similar study gives the hourly cash operating cost of a feed wagon as $0.50.[2/] Hence, the cash operating cost

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1/ Reed, A. D., Machinery Costs and Performance, Davis: California Agricultural Extension Service, 1964, 8 pp., processed.

2/ Strong, Horace T., Richard G. Jones, Robert F. Miller, and Roy V. Parker, Farm Feeding Beef Cattle to Market Home-Grown Feeds, Berkeley: California Agricultural Extension Service Circular 453, 1956, 23 pp.

TABLE 12

Feed Costs per Hundredweight Assumed
for the Eight Brood Sizes[a/]

Type of feed	Brood size (in thousands)			
	5	10	15	20 to 100
percent protein	dollars per cwt.			
28	5.89	5.89	5.84	5.82
24	5.10	5.08	5.08	5.08
20	3.92	3.92	3.92	3.92
18	3.81	3.81	3.81	3.81
16	3.69	3.69	3.69	3.69
14	3.63	3.58	3.56	3.56

a/ Based on the prices quoted in Table 11 and incorporate discounts for quantity purchases where appropriate.

TABLE 13

Labor Requirements and Costs by Brood Size

Type of labor	Brood size							
	5,000	10,000	15,000	20,000	25,000	35,000	50,000	100,000
	hours per 1,000 poults							
Purchasing poults[a/]	4.0	3.0	2.7	2.5	2.4	2.3	2.2	2.1
Preparing houses and equipment[b/]	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Daily care								
First week[c/]	9.2	8.9	8.7	8.4	8.1	7.6	6.7	5.0
Second-eighth week (7 weeks)[c/]	32.2	31.2	30.5	29.4	28.4	26.6	23.4	17.5
Ninth week-market (16 weeks)[d/]	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Feeding in drylot (16 weeks)[e/]	11.2	10.6	9.6	8.6	8.3	8.0	7.7	7.5
Marketing turkeys[f/]	4.0	3.0	2.6	2.5	2.4	2.3	2.2	2.1
TOTAL hours per 1,000 turkeys	91.0	87.1	84.6	81.8	80.0	77.2	72.6	64.6
	hours per brood							
TOTAL hours per brood	455.0	870.1	1,268.2	1,636.8	1,999.2	2,702.0	3,631.5	6,462.0
	dollars per brood							
TOTAL labor cost per brood (at $1.50 per hour)	682.50	1,305.15	1,902.38	2,455.20	2,998.88	4,053.00	5,447.25	9,693.00

a/ Ordering and transporting poults to the ranch is assumed to require ten hours regardless of the size of operation; placing poults in the brooder house requires two hours per 1,000 poults.

b/ From Jolliff, Marvin O., and Robert C. Suter, Turkeys: Costs and Returns, Lafayette: Purdue University, Department of Agricultural Economics, May 1962, 27 pp., processed.

c/ According to Extension specialists, one man and supplementary family labor can care for 20,000 turkeys; two men and supplementary family labor can care for 50,000 during the second through the eighth weeks. The hourly requirements were developed assuming a man provides ten hours of labor per day and his family two hours per day and using straight-line interpolation between operations of different sizes.

d/ The labor required for cleaning the feeders, waterers, removing dead birds, and general flock surveillance is two hours per 10,000 birds per day, or 1.4 hours per 1,000 birds per week.

e/ Feeding on range with a tractor and self-unloading feed wagon is assumed to require 30 minutes for each 2-ton load.

f/ Contacting turkey buyers and getting bids on the flock is assumed to require ten hours. Two hours per 1,000 turkeys are assumed necessary to catch the turkeys and load them on trucks.

Source: Estimates from Extension specialists, growers, and field men of contracting companies.

TABLE 14

Machinery Operating Costs for Turkey
Operations of Various Sizes

Item	Brood size							
	5,000	10,000	15,000	20,000	25,000	35,000	50,000	100,000
	hours per 1,000 poults							
Machine operating time[a/]	11.20	10.56	9.60	8.64	8.32	8.00	7.68	7.52
	dollars per 1,000 poults							
Machine operating costs (at $1.45 per hour)[b/]	16.36	15.31	13.92	12.53	12.06	11.60	11.14	10.90

a/ The hours of machinery operation are based on the hours required for drylot feeding in Table 13.

b/ The machinery cost for fuel and repairs are based on the costs of $0.95 for a 30-horsepower tractor and $0.50 for a feed wagon (Reed, A. D., Machinery Costs and Performance, Davis: California Agricultural Extension Service, 1964, 8 pp. processed) and (Strong, Horace T., Richard G. Jones, Robert F. Miller, and Ray V. Parker, Farm Feeding Beef Cattle to Market Home-Grown Feeds, Berkeley: California Agricultural Extension Service Circular 453, 1956).

of the tractor and feed wagon is assumed to be $1.45 per hour. Table 14 gives the cash operating cost per 1,000 turkeys for each of the eight brood sizes.

Poult costs.--Contracts with hatcheries, with feed firms which purchase poults for contract growers and with independent growers, verified that the purchase price of a broad-breasted bronze poult of good quality is $0.55 or more in California. Sexing poults so that the hens and toms may be separated and raised in separate pens to improve feeding efficiency costs an additional $0.015 per poult. Quantity discounts for larger orders are not commonly available. The only discount ordinarily available on the purchase price of poults occurs in the event that a hatchery has an order cancellation and another grower cannot be found to take the poults at the standard price. Hence, the poult cost per 1,000 poults started is assumed to be $565.00 (1,000 birds at $0.565 per bird) regardless of the size of operation.

Other variable costs.--The cost per 1,000 poults started for medication, litter, insurance, electricity and fuel, and miscellaneous items were obtained from the records of contract growers as summarized in Table 15. In the absence of any evidence of quantity discounts, the cost for these items is assumed to be constant regardless of the size of operation.

Interest on operating capital.--Interest on the amount of money necessary to finance the variable-cost items represents a cost of doing business and, hence, is included as a variable cost in the analysis. Operating capital for turkey production is generally available at simple 6 percent interest per year to growers who have some equity in their operation. Because rearing a brood of turkeys covers approximately six months, the interest charge used in this study is 3 percent of the cost for all the variable inputs. If all the capital is borrowed, the interest is paid as a cash cost. However, if a grower is using his own capital, the interest charge represents interest foregone on his own capital and is therefore an opportunity cost rather than a direct cash cost.

Total variable-cost equation.--The total variable-cost equation per 1,000 poults is obtained by aggregating the input costs per 1,000 poults of each of the ten variable-cost items discussed above. Multiplying this equation by the size of the enterprise (S) in thousands of poults started will give the total variable cost for any enterprise size. To simplify the analysis, the ten variable-cost items can be combined into three groups. Combination of the terms will reduce the length of the equation and simplify the empirical work.

TABLE 15

Cost of Other Variable Inputs
in Turkey Production

Input	Cost per 1,000 poults started
	dollars
Medication	149.00
Litter	17.00
Insurance	34.00
Electricity and brooder fuel	33.00
Miscellaneous	19.00
TOTAL	252.00

Source: Adapted from records of growers raising turkeys under contract with a commercial feed company.

Six of the variable inputs have been considered as constant per 1,000 poults started, regardless of brood or enterprise size. These six items, poult cost (P), medication cost (Me), litter (Li), insurance cost (In), electricity and brooder fuel (E), and miscellaneous items (Mi) can be combined into a constant, K_1, as shown in Equation (23). Total cost of these items for any

$$K_1 = P + Me + Li + In + E + Mi \tag{23}$$

enterprise size can then be represented as K_1S, where S is the enterprise size in thousands of poults started.

Two of the variable-cost items per 1,000 poults started, labor (La) and machinery operating cost (Ma), are a function of the brood size and are combined as shown in Equation (24). In this Equation, K_{2j} represents the cost of

$$K_{2j} = La_j + Ma_j \text{ where } j = 5, 10, 15, 20, 25, 35, 50, \text{ or } 100 \tag{24}$$

labor and machinery per 1,000 poults started for brood size j. The cost for any enterprise size S is given by $K_{2j}S$. This represents the total cost of labor and machinery for enterprise size S where the turkeys are raised in facilities with capacity per brood of j.

The interest charge per 1,000 poults for brood capacity j is given by Equation (25). The interest charge for an enterprise of size S where the turkeys

$$I_j = 0.03(K_1 + K_{2j} + F_j) \text{ where } j = 5, 10, 15, 20, 25, 35, 50, \text{ or } 100 \tag{25}$$

are reared in facilities with capacity per brood of j is given by I_jS. For any given j, the interest Equation (25) becomes a linear function of the total mortality for the season. Consequently, the interest equation is combined with the equation for feed cost and defined as K_{3j} as shown in Equation (26). The total

$$K_{3j} = F_j + I_j = F_j + 0.03(K_1 + K_{2j} + F_j) \tag{26}$$

$$\text{where } j = 5, 10, 15, 20, 25, 35, 50, \text{ or } 100$$

feed and interest charge for an enterprise of size S reared in facilities with a brood capacity of j is given by $K_{3j}S$.

The total variable-cost equation for enterprise size S reared in facilities with brood capacity j is given as Equation (27). Because K_{3j} includes feed cost,

$$T.V.C._j = K_1S + K_{2j}S + K_{3j}S \tag{27}$$

which is a function of mortality rate, the value of K_{3j} itself is a function of the total mortality for the enterprise. Consequently, Equation (27) gives the total variable cost as a linear function of the brood size, enterprise size, and the amount of mortality. The numerical values for K_1, K_{2j}, and K_{3j} are given by brood size in Table 16.

Pounds of Turkey Produced

The pounds of turkey meat produced by a given size of operation must be estimated to compute the average cost of production. The level of mortality (M) affects the number of turkeys and, hence, the pounds of turkey marketed. As indicated, marketing toms five weeks later than hens results in a loss of more tom than hen turkeys, which must be taken into account when computing the pounds of turkey produced. Assuming that each 1,000 turkey poults started are composed of 500 hen turkeys and 500 tom turkeys and that the distribution of mortality over the growing period is given by Equation (1), the number of hen turkeys alive (H_a) at the end of 19 weeks is given by Equation (28).[1/] Using Equation (1), the value for m_{24} is 0.97628, i.e.,

(28) $$H_a = (0.5 - 0.45767M)\ 1{,}000$$

about 98 percent of total death loss has occurred during the 24 weeks of the growing period. The remaining 2 percent of the death loss is accounted for by birds dead on arrival or condemned at the processing plant. Assuming that the birds dead on arrival and condemned (D.O.A.) are divided equally between hen and tom turkeys, Equation (29) gives the number of hen turkeys (H_s) which are sold. The number of tom turkeys sold (T_s) is derived using the relationship given in Equation (30).

(29) $$H_s = (0.5 - 0.45767M - 0.01186M)\ 1{,}000 = (0.5 - 0.46953M)\ 1{,}000$$

(30) $$T_s = [0.5 - m_{24}M + 0.5m_{19}M - 0.5(D.O.A.)]\ 1{,}000$$

$$= (0.5 + 0.53047M)\ 1{,}000$$

Two methods are used to compute the pounds of turkey produced. The first method assumes the growth standards given in Table 9. Using these standards, hens marketed at 19 weeks and toms at 24 weeks would average 14.4 pounds and

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1/ Using Equation (1), $m_{19} = 0.91534$ and $0.5m_{19} = 0.45767$.

TABLE 16

Coefficients for the Total Variable Cost Equation in Turkey Production

Brood size	Cost coefficient		
	K_1	K_{2j}	K_{3j}
	dollars per 1,000 poults started		
5,000	817.00	152.74	2,745.94 - 1,977.32M
10,000	817.00	145.82	2,742.32 - 1,974.54M
15,000	817.00	140.74	2,740.32 - 1,973.26M
20,000	817.00	135.23	2,739.75 - 1,973.06M
25,000	817.00	132.02	2,739.66 - 1,973.06M
35,000	817.00	127.40	2,739.52 - 1,973.06M
50,000	817.00	120.08	2,739.30 - 1,973.06M
100,000	817.00	107.83	2,738.93 - 1,973.06M

Source: The assumptions and method of computation are given in the text.

26.4 pounds, respectively. Combining these coefficients with Equations (29) and (30), the pounds of turkey meat produced per 1,000 poults started (Y) is given by Equation (31). The pounds of turkey produced for any size operation can be predicted by YS.

(31) $Y = 20,400 - 20,765.64M$

Only two of the 36 operations whose records were used in this study reported an average market weight greater than or equal to the standards for hens given in Table 9, while only eight of the 35 operations with tom turkeys reported average market weights greater than or equal to these standards. Consequently, using the growth rates of Table 9 and the quantity of turkey meat produced given by Equation (31) provided estimates of economy-of-scale curves indicative of a "high" or above average level of feed conversion for the brood sizes specified.

As a comparison, it may be useful to compute the cost relationships for growers who attain an average level of feed efficiency. Consequently, a second method of computing market weights, an "adjusted" or "medium" growth rate standard, is also developed and presented for comparison. This adjustment was made by computing the mean age and weight for the hens and toms from the sample records. Then, preserving the same curvature as the standard growth curve over the marketing period, the growth curve was shifted downward so as to run through the mean values of the record data. By preserving the same curvature of the growth curve, the marketing ages of 19 weeks for hens and 24 weeks for toms remain optimum. The results of the adjusted standards indicated an average marketing weight of 13.25 pounds for hens at 19 weeks and 25.5 pounds for 24-week toms. The predicted pounds of turkey meat per 1,000 poults started using the adjusted growth standard (Z) is given by Equation (32). The total quantity of turkey meat marketed for any size of enterprise using the adjusted growth standard is given by ZS.

(32) $Z = 19,200 - 19,562.593M$

Estimates of Short- and Long-Run Average Total Costs

Based on the cost components developed above, two general equations are given representing short-run average total costs (ATC) for producing turkeys assuming "high" and "average" growth rates, respectively.

$$(33) \qquad ATC^{*}_{ij} = \frac{F.C._{ij} + (K_1 + K_{2j} + K_{3j})S}{YS}$$

$$(34) \qquad ATC_{ij} = \frac{F.C._{ij} + (K_1 + K_{2j} + K_{3j})S}{ZS}$$

Where i = number of broods (i = 1 or 2);

j = capacity per brood in thousands (j = 5, 10, 15, 20, 25, 35, 50, and 100);

F.C. = annual fixed costs as given in Table 8;

K_1, K_{2j}, K_{3j} = components of total variable costs as discussed in the text and their numerical values are presented in Table 16;

Y = predicted pounds of turkey meat per 1,000 poults started using the "high" growth rate (Equation 31);

Z = predicted pounds of turkey meat per 1,000 poults started using the adjusted or "average" growth rate (Equation 32); and

S = size of enterprise in thousands of poults.

Based on Equations (33) and (34), total and average costs per pound of turkey produced are derived and presented in Tables 17, 18, and 19 for operations of different sizes. Results are presented for one-brood turkey meat enterprises assuming both high and medium growth rates for 4.00, 9.75, and 20.50 percent mortality, respectively. Corresponding summaries for two-brood enterprises are presented in Tables 20, 21, and 22.

Effects on costs of one brood versus two broods per year.--Although cost comparisons from growing turkeys in single broods versus two broods per year can be made for any of the mortality and growth rates assumed, we illustrate the results only for the situation where mortality is fixed at 9.75 percent and a medium growth rate is assumed. Figure 2 presents this comparison of short- and long-run cost curves based on cost summaries in Tables 18 and 21. In the theoretical discussion presented earlier, the long-run average cost curve (LRAC) is obtained by connecting the points of lowest cost for each of the "fixed plants." Here, LRAC is derived as the locus of lowest costs at

TABLE 17

Budgeted Costs for One Brood Turkey Meat Production Enterprises Assuming 4 Percent Mortality

Building component	Number of poults started	Total fixed cost	Total variable cost	Total cost	High rate of gain			Medium rate of gain		
					Average fixed cost	Average variable cost	Average total cost	Average fixed cost	Average variable cost	Average total cost
	1,000 birds	dollars			dollars per pound					
I	1	3,288	3,636	6,925	0.1681	0.1858	0.3539	0.1785	0.1975	0.3760
	3		10,910	14,198	0.0560		0.2418	0.0595		0.2570
	5		18,182	21,472	0.0336		0.2194	0.0357		0.2332
II	6	5,381	21,757	27,138	0.0458	0.1853	0.2311	0.0487	0.1969	0.2456
	8		29,009	34,390	0.0344		0.2197	0.0365		0.2334
	10		36,262	41,643	0.0275		0.2128	0.0292		0.2261
III	11	7,474	39,810	47,284	0.0348	0.1849	0.2197	0.0369	0.1965	0.2334
	13		47,048	54,522	0.0294		0.2143	0.0312		0.2277
	15		54,287	61,761	0.0255		0.2104	0.0271		0.2236
IV	16	9,566	57,808	67,376	0.0306	0.1846	0.2152	0.0324	0.1962	0.2286
	18		65,035	74,602	0.0272		0.2118	0.0289		0.2250
	20		72,261	81,827	0.0244		0.2091	0.0259		0.2221
V	21	11,659	75,804	87,463	0.0284	0.1845	0.2128	0.0301	0.1960	0.2261
	23		83,024	94,683	0.0259		0.2104	0.0275		0.2235
	25		90,244	101,902	0.0238		0.2083	0.0253		0.2213
VI	27	15,700	97,334	113,036	0.0297	0.1842	0.2139	0.0316	0.1957	0.2273
	31		111,754	127,456	0.0259		0.2101	0.0275		0.2232
	35		126,174	141,876	0.0229		0.2071	0.0244		0.2201
VII	36	21,941	129,508	151,450	0.0312	0.1838	0.2150	0.0331	0.1953	0.2284
	44		158,288	180,230	0.0255		0.2093	0.0271		0.2224
	50		179,872	201,814	0.0224		0.2062	0.0238		0.2191
VIII	65	42,651	233,014	275,666	0.0335	0.1832	0.2167	0.0356	0.1946	0.2302
	80		286,787	329,438	0.0272		0.2104	0.0290		0.2236
	100		358,484	401,136	0.0218		0.2050	0.0232		0.2178

Source: See text.

TABLE 18

Budgeted Costs for One Brood Turkey Meat Production Enterprises Assuming 9.75 Percent Mortality

Building component	Number of poults started	Total fixed cost	Total variable cost	Total cost	High rate of gain			Medium rate of gain		
					Average fixed cost	Average variable cost	Average total cost	Average fixed cost	Average variable cost	Average total cost
	1,000 birds	dollars			dollars per pound					
I	1	3,288	3,522	6,812	0.1790	0.1917	0.3707	0.1902	0.2037	0.3939
	3		10,568	13,857	0.0597		0.2514	0.0634		0.2671
	5		17,614	20,903	0.0358		0.2275	0.0381		0.2418
II	6	5,381	21,076	26,457	0.0488	0.1912	0.2400	0.0519	0.2031	0.2550
	8		28,101	33,482	0.0366		0.2278	0.0389		0.2420
	10		35,126	40,508	0.0293		0.2204	0.0311		0.2342
III	11	7,474	38,556	46,036	0.0370	0.1908	0.2278	0.0393	0.2027	0.2420
	13		45,574	53,048	0.0313		0.2221	0.0333		0.2360
	15		52,585	60,059	0.0271		0.2179	0.0288		0.2315
IV	16	9,566	55,994	65,560	0.0325	0.1905	0.2230	0.0346	0.2024	0.2370
	18		62,992	72,560	0.0289		0.2194	0.0307		0.2331
	20		69,992	79,558	0.0260		0.2165	0.0276		0.2300
V	21	11,659	73,422	85,081	0.0302	0.1903	0.2205	0.0321	0.2022	0.2343
	23		80,414	92,074	0.0276		0.2179	0.0293		0.2315
	25		87,408	99,066	0.0254		0.2157	0.0270		0.2292
VI	27	15,700	94,272	109,972	0.0317	0.1900	0.2217	0.0336	0.2019	0.2355
	31		108,238	123,938	0.0276		0.2176	0.0293		0.2312
	35		122,204	137,904	0.0244		0.2144	0.0259		0.2278
VII	36	21,941	125,424	147,366	0.0332	0.1896	0.2228	0.0352	0.2015	0.2367
	44		153,296	175,238	0.0271		0.2167	0.0288		0.2303
	50		174,200	196,142	0.0239		0.2135	0.0254		0.2269
VIII	65	42,651	225,640	268,292	0.0357	0.1889	0.2246	0.0379	0.2007	0.2387
	80		277,711	320,362	0.0290		0.2179	0.0309		0.2316
	100		347,139	389,790	0.0232		0.2121	0.0247		0.2254

Source: See text.

TABLE 19

Budgeted Costs for One Brood Turkey Meat Production Enterprises Assuming 20.5 Percent Mortality

Building component	Number of poults started	Total fixed cost	Total variable cost	Total cost	High rate of gain			Medium rate of gain		
					Average fixed cost	Average variable cost	Average total cost	Average fixed cost	Average variable cost	Average total cost
	1,000 birds	dollars			dollars per pound					
I	1	3,288	3,310	6,599	0.2037	0.2051	0.4088	0.2165	0.2179	0.4344
	3		9,930	13,220	0.0679		0.2730	0.0722		0.2901
	5		16,552	19,840	0.0407		0.2458	0.0433		0.2612
II	6	5,381	19,802	25,184	0.0556	0.2044	0.2600	0.0590	0.2173	0.2763
	8		26,402	31,784	0.0417		0.2461	0.0443		0.2616
	10		33,004	38,385	0.0334		0.2378	0.0354		0.2527
III	11	7,474	36,229	43,702	0.0421	0.2040	0.2461	0.0448	0.2168	0.2616
	13		42,816	50,290	0.0356		0.2396	0.0379		0.2547
	15		49,403	56,877	0.0309		0.2349	0.0328		0.2496
IV	16	9,566	52,600	62,166	0.0371	0.2036	0.2407	0.0394	0.2164	0.2558
	18		59,175	68,742	0.0330		0.2366	0.0350		0.2514
	20		65,750	75,316	0.0297		0.2333	0.0315		0.2479
V	21	11,659	68,968	80,627	0.0344	0.2034	0.2378	0.0366	0.2162	0.2528
	23		75,536	87,196	0.0314		0.2348	0.0334		0.2496
	25		82,104	93,764	0.0289		0.2323	0.0307		0.2469
VI	27	15,700	88,544	104,246	0.0361	0.2031	0.2392	0.0383	0.2159	0.2542
	31		101,662	117,363	0.0314		0.2345	0.0333		0.2492
	35		114,780	130,481	0.0278		0.2309	0.0295		0.2454
VII	36	21,941	117,788	139,730	0.0377	0.2027	0.2404	0.0401	0.2154	0.2555
	44		143,964	165,905	0.0309		0.2336	0.0328		0.2482
	50		163,595	185,536	0.0272		0.2299	0.0289		0.2443
VIII	65	42,651	211,854	254,505	0.0406	0.2019	0.2425	0.0432	0.2146	0.2578
	80		260,743	303,394	0.0330		0.2349	0.0351		0.2497
	100		325,928	268,580	0.0264		0.2283	0.0281		0.2427

Source: See text.

TABLE 20

Budgeted Costs for Two Brood Turkey Meat Production Enterprises Assuming 4 Percent Mortality

Building component	Number of poults started	Total fixed cost	Total variable cost	Total cost	High rate of gain			Medium rate of gain		
					Average fixed cost	Average variable cost	Average total cost	Average fixed cost	Average variable cost	Average total cost
	1,000 birds	dollars			dollars per pound					
I	6	4,866	21,820	26,685	0.0415	0.1858	0.2273	0.0440	0.1975	0.2415
	8		29,092	33,958	0.0311		0.2169	0.0330		0.2305
	10		36,366	41,231	0.0249		0.2107	0.0264		0.2239
II	12	8,226	43,514	51,740	0.0350	0.1853	0.2203	0.0372	0.1969	0.2341
	16		58,018	66,244	0.0263		0.2116	0.0279		0.2248
	20		72,523	80,749	0.0210		0.2063	0.0223		0.2192
III	22	11,386	79,620	91,006	0.0265	0.1849	0.2114	0.0281	0.1965	0.2246
	26		94,098	105,483	0.0224		0.2073	0.0238		0.2203
	30		108,574	119,960	0.0194		0.2043	0.0206		0.2171
IV	32	14,678	115,618	130,296	0.0235	0.1846	0.2081	0.0249	0.1962	0.2211
	36		130,070	144,749	0.0209		0.2055	0.0221		0.2183
	40		144,522	159,201	0.0188		0.2034	0.0199		0.2161
V	42	17,972	151,610	169,582	0.0218	0.1845	0.2063	0.0232	0.1960	0.2192
	46		166,048	184,021	0.0199		0.2044	0.0212		0.2172
	50		180,488	198,460	0.0183		0.2028	0.0195		0.2155
VI	54	23,739	194,670	218,409	0.0225	0.1842	0.2067	0.0239	0.1957	0.2196
	62		223,510	247,249	0.0196		0.2038	0.0208		0.2165
	70		252,350	276,089	0.0173		0.2015	0.0185		0.2142
VII	72	33,422	259,016	292,440	0.0238	0.1838	0.2076	0.0252	0.1953	0.2205
	88		316,576	349,999	0.0194		0.2032	0.0207		0.2160
	100		359,746	393,168	0.0171		0.2009	0.0182		0.2135
VIII	140	66,846	501,878	568,724	0.0244	0.1832	0.2076	0.0260	0.1946	0.2206
	170		609,423	676,269	0.0201		0.2033	0.0214		0.2160
	200		716,968	783,814	0.0171		0.2003	0.0182		0.2128

Source: See text.

TABLE 21

Budgeted Costs for Two Brood Turkey Meat Production Enterprises Assuming 9.75 Percent Mortality

Building component	Number of poults started	Total fixed cost	Total variable cost	Total cost	High rate of gain			Medium rate of gain		
					Average fixed cost	Average variable cost	Average total cost	Average fixed cost	Average variable cost	Average total cost
	1,000 birds	dollars			dollars per pound					
I	6	4,866	21,137	26,002	0.0441	0.1917	0.2358	0.0469	0.2037	0.2506
	8		28,183	33,048	0.0331		0.2248	0.0352		0.2389
	10		35,228	40,094	0.0265		0.2182	0.0282		0.2319
II	12	8,226	42,152	50,378	0.0373	0.1912	0.2285	0.0397	0.2031	0.2428
	16		56,202	64,428	0.0279		0.2191	0.0298		0.2329
	20		70,252	78,478	0.0223		0.2135	0.0238		0.2269
III	22	11,386	77,124	88,510	0.0281	0.1908	0.2189	0.0300	0.2027	0.2327
	26		91,147	102,533	0.0238		0.2146	0.0253		0.2280
	30		105,170	116,556	0.0206		0.2114	0.0220		0.2247
IV	32	14,678	111,988	126,666	0.0249	0.1905	0.2154	0.0265	0.2024	0.2289
	36		125,986	140,664	0.2219		0.2126	0.0236		0.2260
	40		139,984	154,663	0.0199		0.2104	0.0212		0.2236
V	42	17,972	146,844	164,817	0.0233	0.1903	0.2136	0.0247	0.2022	0.2269
	46		160,830	178,802	0.0212		0.2115	0.0226		0.2248
	50		174,815	192,788	0.0195		0.2098	0.0208		0.2230
VI	54	23,739	188,543	212,282	0.0239	0.1900	0.2139	0.0254	0.2019	0.2273
	62		216,476	240,215	0.0208		0.2108	0.0222		0.2241
	70		244,408	268,148	0.0185		0.2085	0.0196		0.2215
VII	72	33,422	250,848	284,271	0.0253	0.1896	0.2149	0.0268	0.2015	0.2283
	88		306,592	340,016	0.0207		0.2103	0.0219		0.2234
	100		348,400	381,824	0.0182		0.2078	0.0193		0.2208
VIII	140	66,846	485,994	552,840	0.0260	0.1889	0.2149	0.0277	0.2007	0.2284
	170		590,136	656,982	0.0214		0.2103	0.0227		0.2234
	200		694,278	761,124	0.0182		0.2071	0.0194		0.2201

Source: See text.

TABLE 22

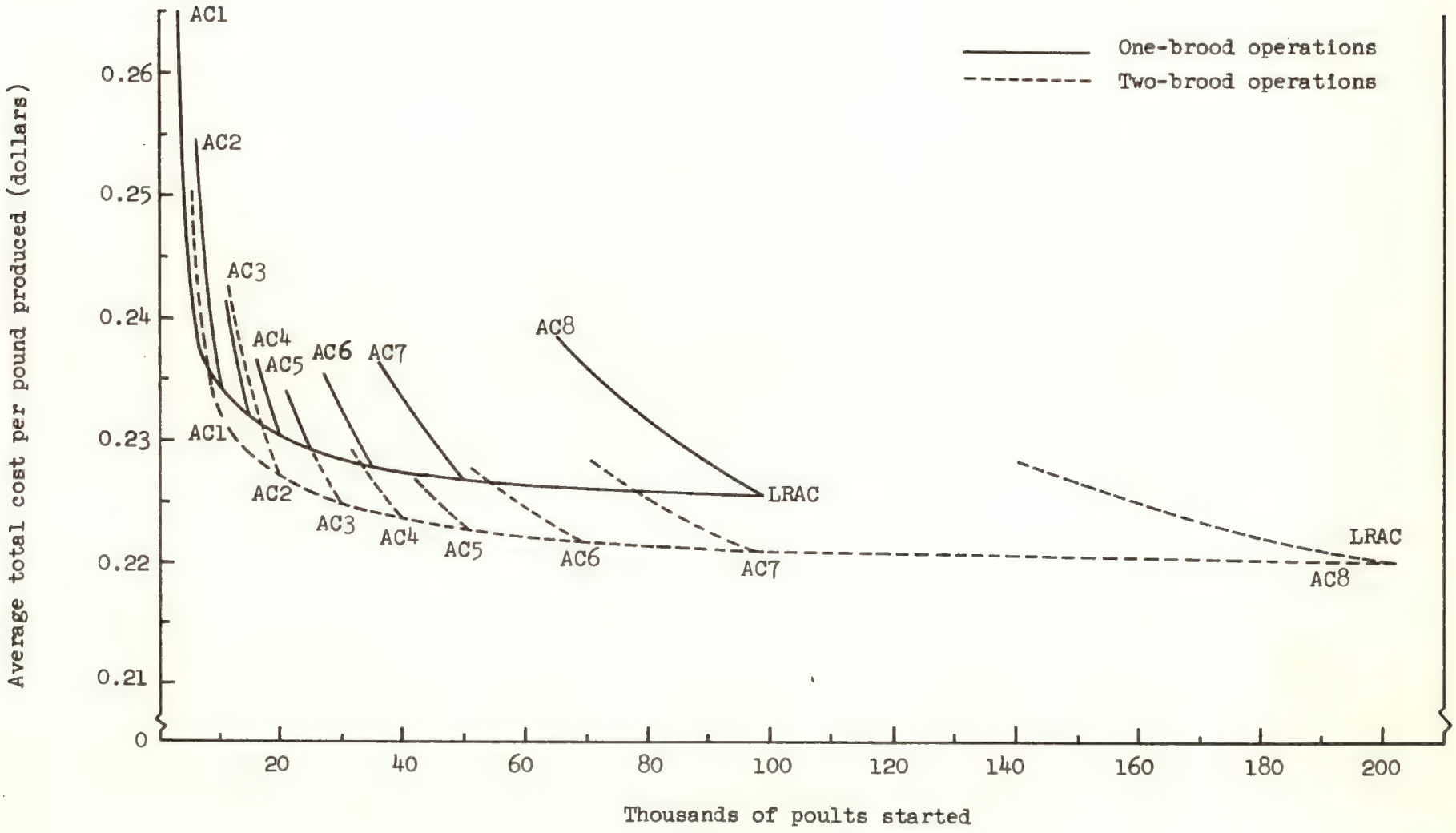
Budgeted Costs for Two Brood Turkey Meat Production Enterprises Assuming 20.5 Percent Mortality

Building component	Number of poults started	Total fixed cost	Total variable cost	Total cost	High rate of gain			Medium rate of gain		
					Average fixed cost	Average variable cost	Average total cost	Average fixed cost	Average variable cost	Average total cost
	1,000 birds	dollars			dollars per pound					
I	6	4,866	19,862	24,728	0.0502	0.2051	0.2553	0.0534	0.2179	0.2713
	8		26,482	31,348	0.0377		0.2427	0.0401		0.2580
	10		33,103	37,968	0.0301		0.2352	0.0321		0.2500
II	12	8,226	39,604	47,830	0.0425	0.2044	0.2469	0.0451	0.2173	0.2624
	16		52,806	61,032	0.0319		0.2363	0.0338		0.2511
	20		66,007	74,233	0.0255		0.2299	0.0270		0.2443
III	22	11,386	72,458	83,844	0.0321	0.2040	0.2361	0.0341	0.2168	0.2509
	26		85,632	97,018	0.0271		0.2311	0.0289		0.2457
	30		98,806	110,192	0.0235		0.2275	0.0250		0.2418
IV	32	14,678	105,200	119,879	0.0284	0.2036	0.2321	0.0302	0.2164	0.2466
	36		118,350	133,029	0.0253		0.2289	0.0269		0.2433
	40		131,500	146,179	0.0228		0.2264	0.0242		0.2406
V	42	17,972	137,936	155,908	0.0266	0.2034	0.2300	0.0282	0.2162	0.2444
	46		151,073	169,046	0.0242		0.2276	0.0257		0.2419
	50		164,210	182,182	0.0223		0.2257	0.0237		0.2399
VI	54	23,739	177,090	200,829	0.0273	0.2031	0.2304	0.0289	0.2159	0.2448
	62		203,325	227,064	0.0238		0.2269	0.0252		0.2411
	70		229,560	253,300	0.0211		0.2242	0.0223		0.2382
VII	72	33,422	235,576	269,000	0.0287	0.2027	0.2314	0.0306	0.2154	0.2460
	88		287,927	321,350	0.0235		0.2262	0.0250		0.2404
	100		327,190	360,613	0.0207		0.2234	0.0220		0.2374
VIII	140	66,846	456,300	523,146	0.0296	0.2019	0.2315	0.0314	0.2146	0.2460
	170		554,078	620,924	0.0244		0.2263	0.0259		0.2405
	200		651,858	718,703	0.0207		0.2226	0.0220		0.2366

Source: See text.

FIGURE 2

Average Cost Curves for Eight Sizes of One- and Two-Brood Operations and the Long-Run Planning Curve Assuming 9.75 Percent Mortality and Medium Rate of Gain



capacity for each of the short-run curves AC1 to AC8. Note that for the smallest plant size (AC1), the one-brood operation at capacity (5,000 birds) shows costs exceeding that for the two-brood operation by $0.0099 ($0.2418 versus $0.2319) per pound of turkey. This difference declines to $0.0053 when comparing one- and two-brood operations for the large plant (AC8). A second comparison may be made by considering the difference in the average cost of production of raising the same number of turkeys by a one- or two-brood operation. Raising 10,000 turkeys in one brood using building Component II (i.e., AC2) results in a production cost of $0.2342 per pound while two broods of 5,000 birds can be raised with building Component I at an average total cost of $0.2319 per pound. Likewise, raising 100,000 turkeys in one brood with building Component VIII results in an average total cost of $0.2254 per pound, while raising two broods of 50,000 birds each with building Component VII has an average cost of production of $0.2208 per pound.

Effects of mortality level on costs.--Figure 3 shows the effects of three mortality levels on short- and long-run cost curves for the two-brood medium-growth rate case, based on costs summarized in Tables 20, 21, and 22. The results indicate that for the 4 percent mortality level the average production cost declines from $0.2239 to $0.2128 per pound as the size of operation increases from 10,000 poults to 200,000 poults started per year. With a 9.75 percent mortality rate, approximately an average death loss, the average production cost declines from $0.2319 to $0.2201 per pound over the same size range. For the 20.50 percent mortality, the minimum average cost of production declines from $0.2500 to $0.2366 over the range considered. Hence, increasing the mortality rate from 4.00 percent to 9.75 percent increases the cost of production $0.0070 per pound and a further increase from 9.75 percent to 20.50 percent increases the cost of production an additional $0.0170 per pound. The three mortality rates used in Figure 3 were selected because they represent a lower limit to the mortality rate a grower may expect, the expected mortality rate, and a mortality rate which should rarely be exceeded.

Effects of growth rate on costs.--Comparison of short- and long-run cost curves for the high and medium growth rate assuming the "most likely" situation of two broods and 9.75 percent mortality is shown in Figure 4, based on costs summarized in Table 21. For the medium growth rate, LRAC declines from $0.2319 for 10,000 birds (two broods of 5,000 birds) to $0.2201 per pound for 200,000

FIGURE 3

Average Cost Curves for Eight Sizes of Two-Brood Operations and the Long-Run Planning Curve Using the Medium Growth Rate and Three Alternative Mortality Rates

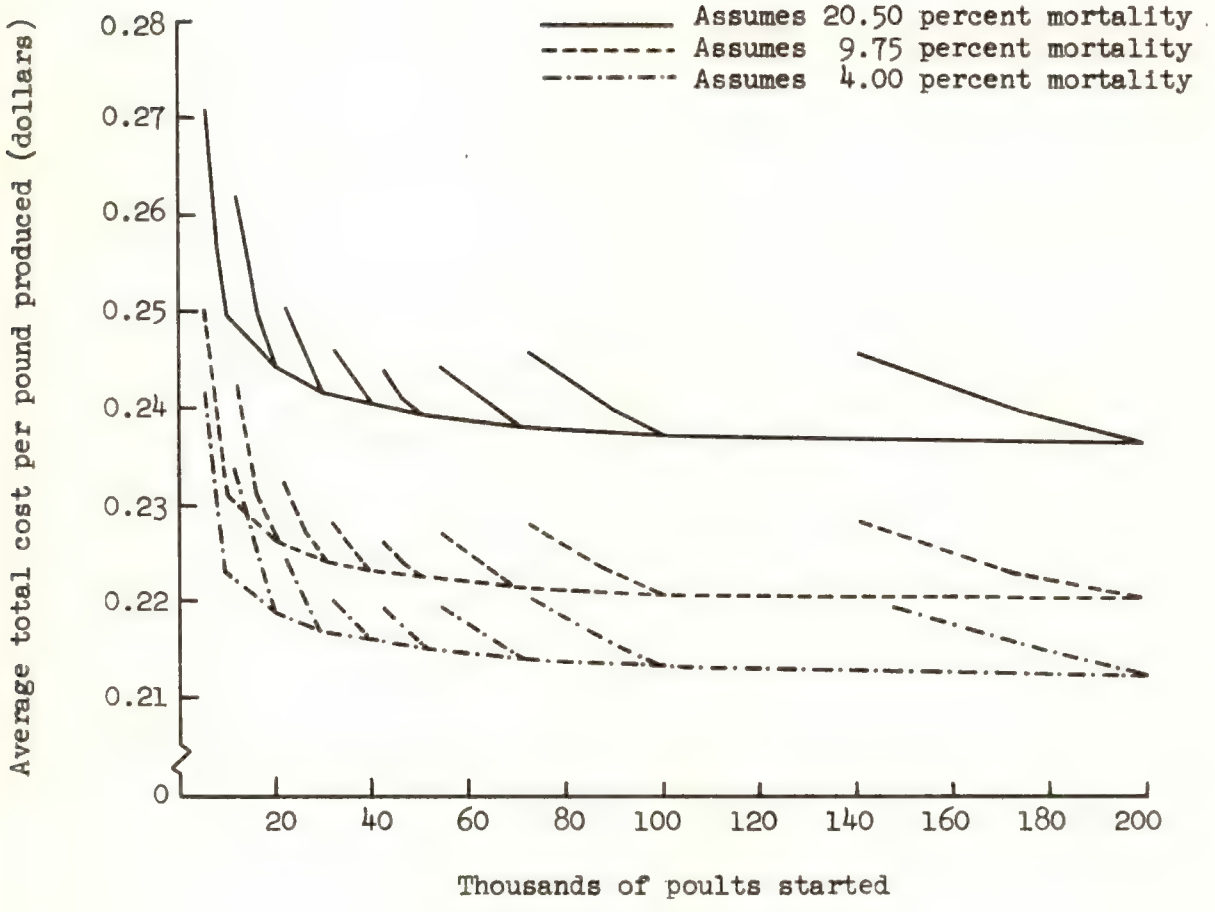
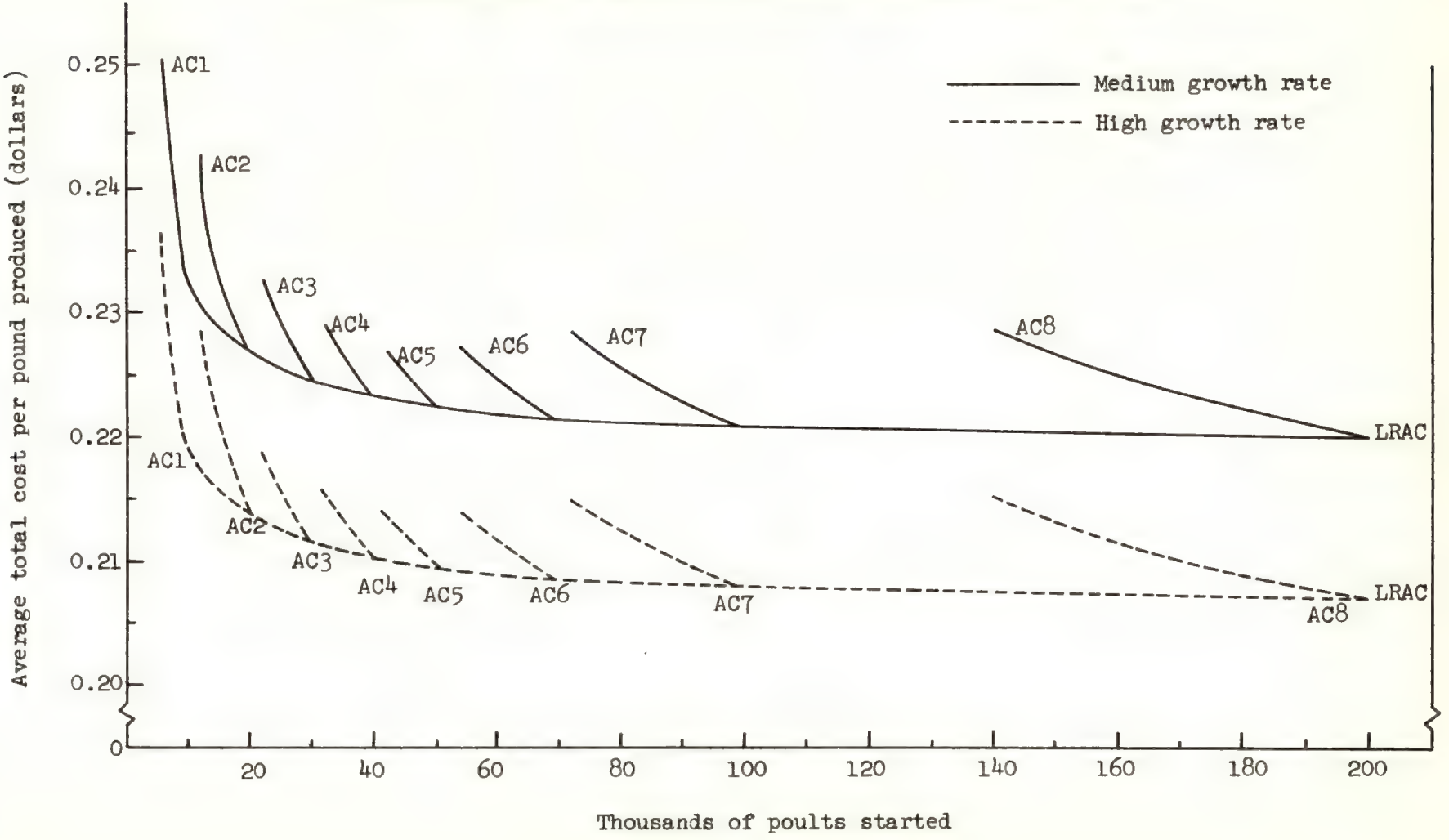


FIGURE 4

Short- and Long-Run Average Cost Curves for Two-Brood Operations with Alternative Growth Rates (9.75 percent mortality rate assumed)



birds started (two broods of 100,000 birds). The comparable costs for the high-growth-rate curve are $0.2182 and $0.2071, respectively--the difference between the two growth rates accounting for about $0.0130 per pound.

Effects of contracting on costs.--The influence of contracting, if any, on production costs of California turkey growers is difficult to assess. Six off-farm concerns offering contracts to California turkey growers in 1963 were interviewed to gain information about the provisions of the turkey meat production contracts, the effect of large volume purchases of poults and other inputs on the prices contractors pay for inputs, and the general experience of contractors with this endeavor. Of the six concerns interviewed, five were offering contracts to turkey growers in 1964. The discussion which follows relates to the provisions of the contracts offered in 1964.

The provisions of the contracts available to California turkey meat producers tend to be uniform and typically relate to the ownership of the flock furnishing of inputs, care and marketing of the turkeys, and the determination of the payments growers will receive. The contracts of the firms interviewed either specified the amount of building and equipment space as a part of the contract or had a similar list of requirements which must be met before the contract was offered to the grower. These requirements were essentially identical with the physical requirements specified for building, pen, feeder, and water space specified in developing the annual cost data in the initial portion of this section. The cleaning and sanitation procedures required for all buildings, equipment, and facilities used in turkey production prior to placement of the poults were also included. The contracts typically included the feeding program to be followed and the procedures to be followed in daily care of the growing turkeys. The contractor (the off-farm firm) furnished the poults, feed, grit, vaccines, litter, brooder fuel, insurance on the poults, sanitation products, and, consequently, maintained ownership of the flock. The grower was required to furnish all land, buildings, equipment, water, labor, and facilities to care for the growing turkeys. All of the contracts established the right of the contractor's field representative to inspect the flock at any time and make recommendations which the grower must follow, or allowed the contractor to hire other labor to care for the turkeys on the grower's premises. Finally, the contracts established a method of computing the growers' payment and a procedure for paying it. The payment procedures varied somewhat among companies, and will be examined in detail later in this report.

It seems reasonable that contractors, by purchasing poults, feed, medication supplies, litter, and fuel in quantity, might obtain lower input prices. We investigated the input prices furnished by contractors through personal interviews with representatives of the contracting concerns and verified them by studying the prices charged to contract growers' accounts. The poult prices charged to contractors are apparently the same as those charged independent growers. The Fair Trade Laws prohibit different price discounts on a given size of feed order delivered to a contract producer as compared to an independent grower. The other inputs furnished by the contractor are typically purchased locally by the grower and charged to the contracting concern. Consequently, it does not appear that inputs for contract growers are purchased at lower prices than those purchased by independent growers.

Because contracting does not influence either the purchase prices of inputs or the quantity of inputs required for a "given level of management," perhaps the major influence of contracting on average production cost is on the "level of management" or the "amount of the managerial input." The field representatives of the contracting concerns should be able to provide managerial assistance for growers not following acceptable practices. However, it is doubtful if the field representatives can improve greatly the performance of "efficient growers." Obviously, the influence on average production cost of the managerial assistance provided by the contracting concern will depend largely on the individual grower. An analysis of this effect, a sizeable independent study, will not be attempted here. Moreover, this study assumes that we are dealing with growers who can raise turkeys for meat production efficiently as either independent or contract growers.

Therefore, the average total cost of production (including all fixed and variable inputs) for independent and contract growers is considered to be identical for any given size of enterprise. However, under contract production the grower furnishes only the fixed inputs, his labor, and machinery operating expense. That is, he furnishes the items included in the annual fixed costs and the item included in K_{2j} of the development of average total cost (see Equation (33)). The contractor furnishes all variable inputs included in K_1 and K_{3j}. Obviously, the capital requirement for contract growers is a good deal less than for independent growers, even though the average total cost of production is the same in either case.

SUMMARY AND CONCLUSIONS

Turkey meat production in California has been shifting toward fewer but larger flocks. The number of turkey growers declined from 1,384 in 1959 to 638 in 1961. During the same period, California growers marketing less than 10,000 turkeys per year declined both in numbers and relative importance, those marketing 10,000 to 20,000 birds declined in numbers but gained in relative importance, while those marketing in excess of 20,000 turkeys per year gained in both numbers and relative importance.

During this period, contracting became an important new method of financing California turkey production. This study indicates that, in 1961, 32 percent of the growers raised 45 percent of California's turkeys under contract; 66 percent produced one-half of the turkeys as independent growers; and the remainder used a combination of independent and contract production.

In this long-run average cost functions were synthesized for turkey farms ranging from two broods of 5,000 to 100,000 birds per year. Using an average feed efficiency rate (i.e., the feed efficiency rate for growers of average efficiency), the average total production cost estimated for two broods of 5,000 turkeys was $0.229 per pound. Increasing the size to two broods of 100,000 turkeys resulted in an average total cost of production of $0.218 per pound, or a decline of 5 percent in the average total cost of production. Of the 5 percent decline in average total cost, approximately 4 percent is available to an enterprise as large as two broods of 20,000 and the average total cost of production is relatively constant for operations with two broods of 50,000 or more.

The position of the long-run average cost curve was very sensitive to mortality rates and to rates of feed efficiency achieved. For example, an operation of 10,000 poults had average costs ranging from $0.2239 to $0.2500 per pound when the mortality rate was varied from 4 to 20 percent. For the same operation, costs dropped from $0.2319 to $0.2182 per pound if the grower could achieve the higher feed efficiency rate rather than the average rate with his flock.

An investigation of the effect of contracting on production costs suggests that contracting neither reduces the quantity nor the price of inputs used by efficient independent growers and hence does not reduce the average total cost

of production. The contractor furnishes all of the variable inputs except labor and the machinery operating expense. Thus, contracting greatly reduces the amount of capital a grower needs to produce turkeys. The managerial assistance provided by contractors through their field men may significantly reduce the average cost of production for some "less efficient" growers. Consequently, the effect of contracting on the average cost of production will vary from grower to grower. It will not affect the economies of scale curve for the typical efficient firm in the industry.